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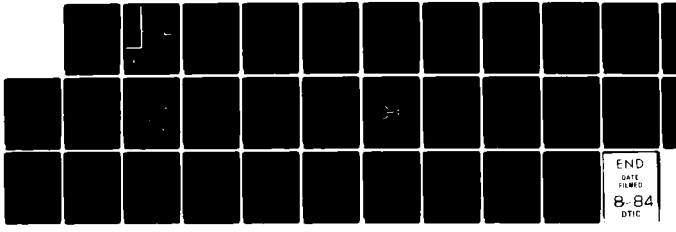

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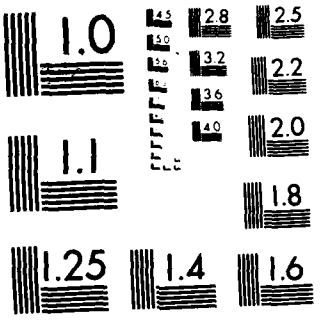

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AD-A142 781

ASD(ENA)-TR-82-5031
VOLUME VI

2nd AFSC STANDARDIZATION CONFERENCE

COMBINED PARTICIPATION BY:
DOD-ARMY-NAVY-AIR FORCE-NATO

30 NOVEMBER - 2 DECEMBER 1982
TUTORIALS: 29 NOVEMBER 1982

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MIL-STD-1679
WEAPON SYSTEM SOFTWARE DEVELOPMENT

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This report has been reviewed by the Office of Public Affairs (ASD/PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

Jeffery L Pesler

JEFFERY L. PESLER
Vice Chairman
2nd AFSC Standardization Conference

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Chief, Avionics Systems Division
Directorate of Avionics Engineering

FOR THE COMMANDER

Robert P Lavoie

ROBERT P. LAVOIE, COL, USAF
Director of Avionics Engineering
Deputy for Engineering

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ASD(ENA)-TR-82-5031, VOLUME IV I	2. GOVT ACCESSION NO. AD-A142 781	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Proceedings Papers of the Second AFSC Avionics Standardization Conference		5. TYPE OF REPORT & PERIOD COVERED Final Report 29 November - 2 December 1982 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Editor: Cynthia A. Porubcansky		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS HQ ASD/ENAS Wright-Patterson AFB OH 45433		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS HQ ASD/ENA Wright-Patterson AFB OH 45433		12. REPORT DATE November 1982 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) Same as Above		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

N/A

18. SUPPLEMENTARY NOTES

N/A

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Computer Instruction Set Architecture, Multiplexing, Compilers, Support Software, Data Bus, Rational Standardization, Digital Avionics, System Integration, Stores Interface, Standardization, MIL-STD-1553, MIL-STD-1589 (JOVIAL), MIL-STD-1750, MIL-STD-1760, MIL-STD-1815 (ADA), MIL-STD-1862 (NEBULA).

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This is a collection of UNCLASSIFIED papers to be distributed to the attendees of the Second AFSC Avionics Standardization Conference at the Convention Center, Dayton, Ohio. The scope of the Conference includes the complete range of DoD approved embedded computer hardware/software and related interface standards as well as standard subsystems used within the Tri-Service community and NATO. The theme of the conference is "Rational Standardization". Lessons learned as well as the pros and cons of standardization are highlighted.

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This is Volume 6

Volume 1	Proceedings pp. 1-560
Volume 2	Proceedings pp. 561-1131
Volume 3	Governing Documents
Volume 4	MIL-STD-1553 Tutorial
Volume 5	MIL-STD-1589 Tutorial
Volume 6	MIL-STD-1679 Tutorial
Volume 7	MIL-STD-1750 Tutorial
Volume 8	MIL-STD-1815 Tutorial
Volume 9	Navy Case Study Tutorial

PROCEEDINGS OF THE

2nd AFSC STANDARDIZATION CONFERENCE

30 NOVEMBER - 2 DECEMBER 1982

DAYTON CONVENTION CENTER
DAYTON, OHIO

Sponsored by:

Air Force Systems Command

Hosted by:

Aeronautical Systems Division

FOREWORD

THE UNITED STATES AIR FORCE HAS COMMITTED ITSELF TO "STANDARDIZATION." THE THEME OF THIS YEAR'S CONFERENCE IS "RATIONAL STANDARDIZATION," AND WE HAVE EXPANDED THE SCOPE TO INCLUDE US ARMY, US NAVY AND NATO PERSPECTIVES ON ONGOING DOD INITIATIVES IN THIS IMPORTANT AREA.

WHY DOES THE AIR FORCE SYSTEMS COMMAND SPONSOR THESE CONFERENCES? BECAUSE WE BELIEVE THAT THE COMMUNICATIONS GENERATED BY THESE GET-TOGETHERS IMPROVE THE ACCEPTANCE OF OUR NEW STANDARDS AND FOSTERS EARLIER, SUCCESSFUL IMPLEMENTATION IN NUMEROUS APPLICATIONS. WE WANT ALL PARTIES AFFECTED BY THESE STANDARDS TO KNOW JUST WHAT IS AVAILABLE TO SUPPORT THEM: THE HARDWARE; THE COMPLIANCE TESTING; THE TOOLS NECESSARY TO FACILITATE DESIGN, ETC. WE ALSO BELIEVE THAT FEEDBACK FROM PEOPLE WHO HAVE USED THEM IS ESSENTIAL TO OUR CONTINUED EFFORTS TO IMPROVE OUR STANDARDIZATION PROCESS. WE HOPE TO LEARN FROM OUR SUCCESSES AND OUR FAILURES; BUT FIRST, WE MUST KNOW WHAT THESE ARE AND WE COUNT ON YOU TO TELL US.

AS WE DID IN 1980, WE ARE FOCUSING OUR PRESENTATIONS ON GOVERNMENT AND INDUSTRY EXECUTIVES, MANAGERS, AND ENGINEERS AND OUR GOAL IS TO EDUCATE RATHER THAN PRESENT DETAILED TECHNICAL MATERIAL. WE ARE STRIVING TO PRESENT, IN A SINGLE FORUM, THE TOTAL AFSC STANDARDIZATION PICTURE FROM POLICY TO IMPLEMENTATION. WE HOPE THIS INSIGHT WILL ENABLE ALL OF YOU TO BETTER UNDERSTAND THE "WHY'S AND WHEREFORE'S" OF OUR CURRENT EMPHASIS ON THIS SUBJECT.

MANY THANKS TO A DEDICATED TEAM FROM THE DIRECTORATE OF AVIONICS ENGINEERING FOR ORGANIZING THIS CONFERENCE; FROM THE OUTSTANDING TECHNICAL PROGRAM TO THE UNGLAMOROUS DETAILS NEEDED TO MAKE YOUR VISIT TO DAYTON, OHIO A PLEASANT ONE. THANKS ALSO TO ALL THE MODERATORS, SPEAKERS AND EXHIBITORS WHO RESPONDED IN SUCH A TIMELY MANNER TO ALL OF OUR PLEAS FOR ASSISTANCE.

ROBERT P. LAVOIE, COL, USAF
DIRECTOR OF AVIONICS ENGINEERING
DEPUTY FOR ENGINEERING

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR FORCE SYSTEMS COMMAND
ANDREWS AIR FORCE BASE DC 20334

28 AUG 1982

REPLY TO ATTN OF: CV

SUBJECT: Second AFSC Standardization Conference

TO: ASD/CC

1. Since the highly successful standardization conference hosted by ASD in 1980, significant technological advancements have occurred. Integration of the standards into weapon systems has become a reality. As a result, we have many "lessons learned" and cost/benefit analyses that should be shared within the tri-service community. Also, this would be a good opportunity to update current and potential "users." Therefore, I endorse the organization of the Second AFSC Standardization Conference.

2. This conference should cover the current accepted standards, results of recent congressional actions, and standards planned for the future. We should provide the latest information on policy, system applications, and lessons learned. The agenda should accommodate both government and industry inputs that criticize as well as support our efforts. Experts from the tri-service arena should be invited to present papers on the various topics. Our AFSC project officer, Maj David Hammond, HQ AFSC/ALR, AUTOVON 858-5731, is prepared to assist.

ROBERT M. BOND, Lt Gen, USAF
Vice Commander

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MIL-STD-1679

WEAPON SYSTEM SOFTWARE DEVELOPMENT

Instructor: Jack Cooper
Anchor Software Management, Inc.

ABSTRACT

MIL-STD-1679 is appearing on more and more Government contracts. The Navy and several other Government agencies are using it extensively on all contracts that contain software development.

This MIL-STD-1679 Tutorial covers:

- o Detailed presentation of the requirements.
- o Interpretation and intent behind the requirements.
- o Relationship to other Military Standards.
- o How to "tailor" MIL-STD-1679 to a contract.
- o Practical application of MIL-STD-1679 to a contract.
- o Changes to MIL-STD-1679 that are taking place.

MIL-STD-1679 Tutorial also provides an opportunity to discuss, ask questions, get answers, share experiences and exchange ideas with the speaker and other attendees.

BIOGRAPHY

Jack Cooper
President, Anchor Software Management, Ltd.
P. O. Box 11208
Alexandria, VA 22312

Prior to his retirement from the Navy Mr. Cooper was the Assistant, for Software Management, to the Director, Computer Resource Office, Headquarters, Naval Material Command (NAVMAT). During this tour he led the development effort for MIL-STD-1679, "Weapon System Software Development". Mr. Cooper was also responsible for policy, standards, and procedures for software acquisition, development and application within NAVMAT.

His involvement in the development of MIL-STD-1679, plus his vast range of military and civilian experiences uniquely qualify Mr. Cooper to present this Tutorial on MIL-STD-1679.

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MIL-STD-1679
"Weapon System Software Development"

By
Jack Cooper

C.A.C.I.

MILITARY SPECIFICATIONS AND STANDARDS

- Specifications vs Standards
- Ground Rules: Conform to requirements of MIL-STD-962
  - — Written in contract-like language
  - — Application limited to the scope of the contract
  - — Cannot contain a requirement on the government
  - — Specify "what" rather than "how" to
  - — Contain only a description of work to be performed
  - — Deliverables (including documentation) cannot be referenced in the body of the standard
- DD Form 1423, Contract Data Requirements List (CDRL) is the vehicle for ordering documentation
- Tailoring conflicts with the purpose of MIL-STDs

MIL-STD-1679, "WEAPON SYSTEM SOFTWARE DEVELOPMENT"

- It is not a system standard
- Encompasses the total software development process
- Specifies the minimum amount of work and documentation required regardless of the size and type of development
- Incorporates state-of-the-art software engineering practices and procedures, such as:
  - Top-down software development methodology
  - Structured programming
  - Verification and validation
  - Programming standards and conventions
  - Computer resource reserves
  - Design and code walk-throughs
  - Use of a high-level language

MIL-STD-1679's PURPOSE

- Purpose: "Establishes uniform requirements for the development of weapon system software within the Department of Defense"
- To fill a contracting void
- To improve the maintainability of software entering the DOD inventory
- To prevent recurrence of historical software acquisition problems

INDIRECT BENEFITS

- Safe for blind application
- A crutch for software naive managers
- Promotes standardization of:
  - Programming standards and conventions
  - Computer program documentation
  - Definition and priorities of software errors
  - Software change vehicles
- Prevents certain "gotcha's" by contractors

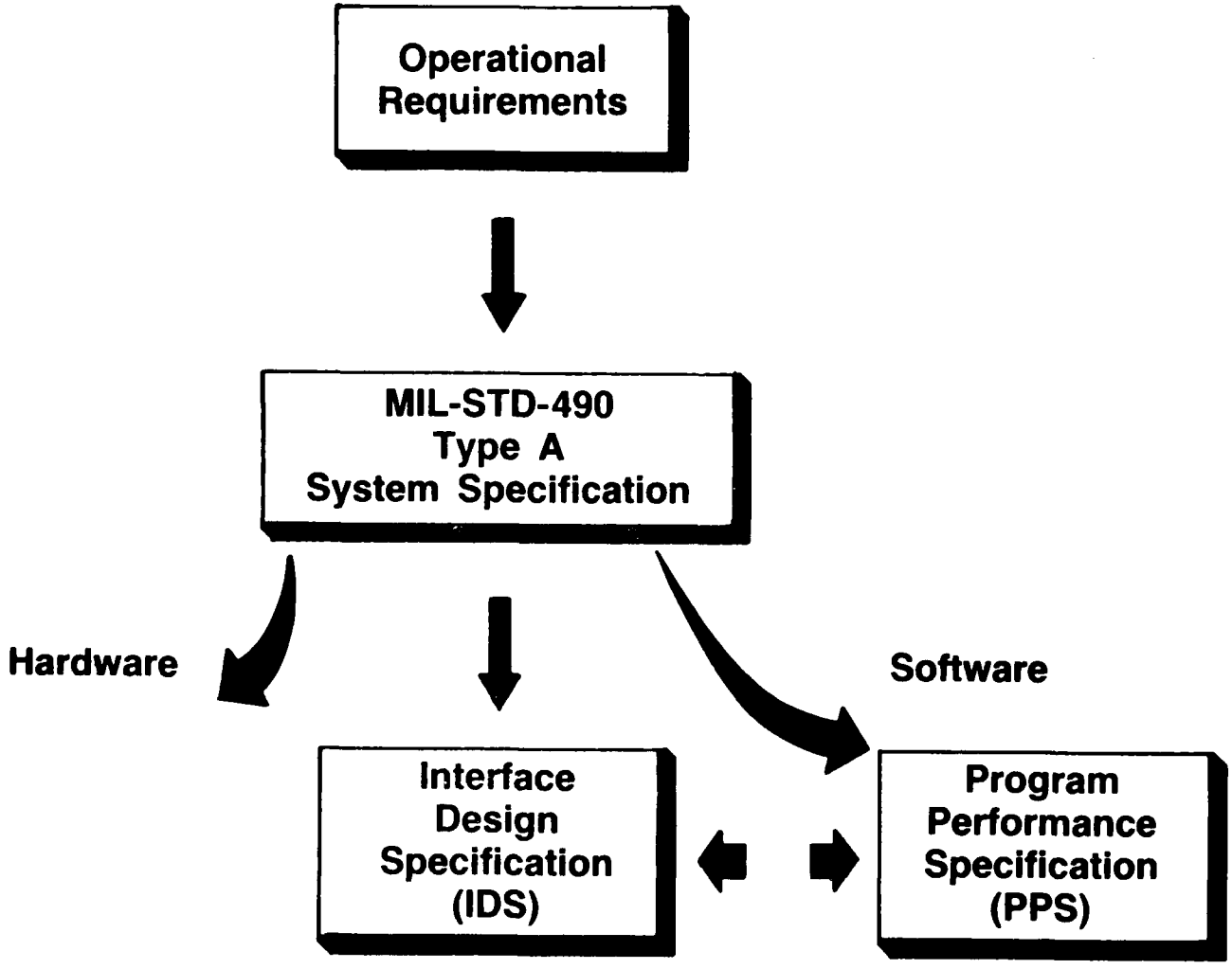
PURPOSE OF COMPUTER PROGRAM DOCUMENTATION

- Physical manifestation of a computer program
- Vehicle for delivery of a program
- Description of the design
- Definition of the program itself
- Description of the tests
- Definition of the management baselines
- Configuration control tool
- Development management tool
- Software maintenance tool
- Future program enhancements
- Operator and user instructions

MYTH: THE COST OF COMPUTER PROGRAM DOCUMENTATION IS EXCESSIVE

- Recall all the uses for documentation
- Documentation is labor-intensive
- Cost components of documentation:
  - Paper and ink
  - Printing and binding
  - Tech writing, editing, and typing
  - Labor
  - Engineering effort
  - Human creativity
- The physical manifestation of the design of a computer program
- Incomplete documentation vs after-the-fact documentation

DOCUMENTATION TREE



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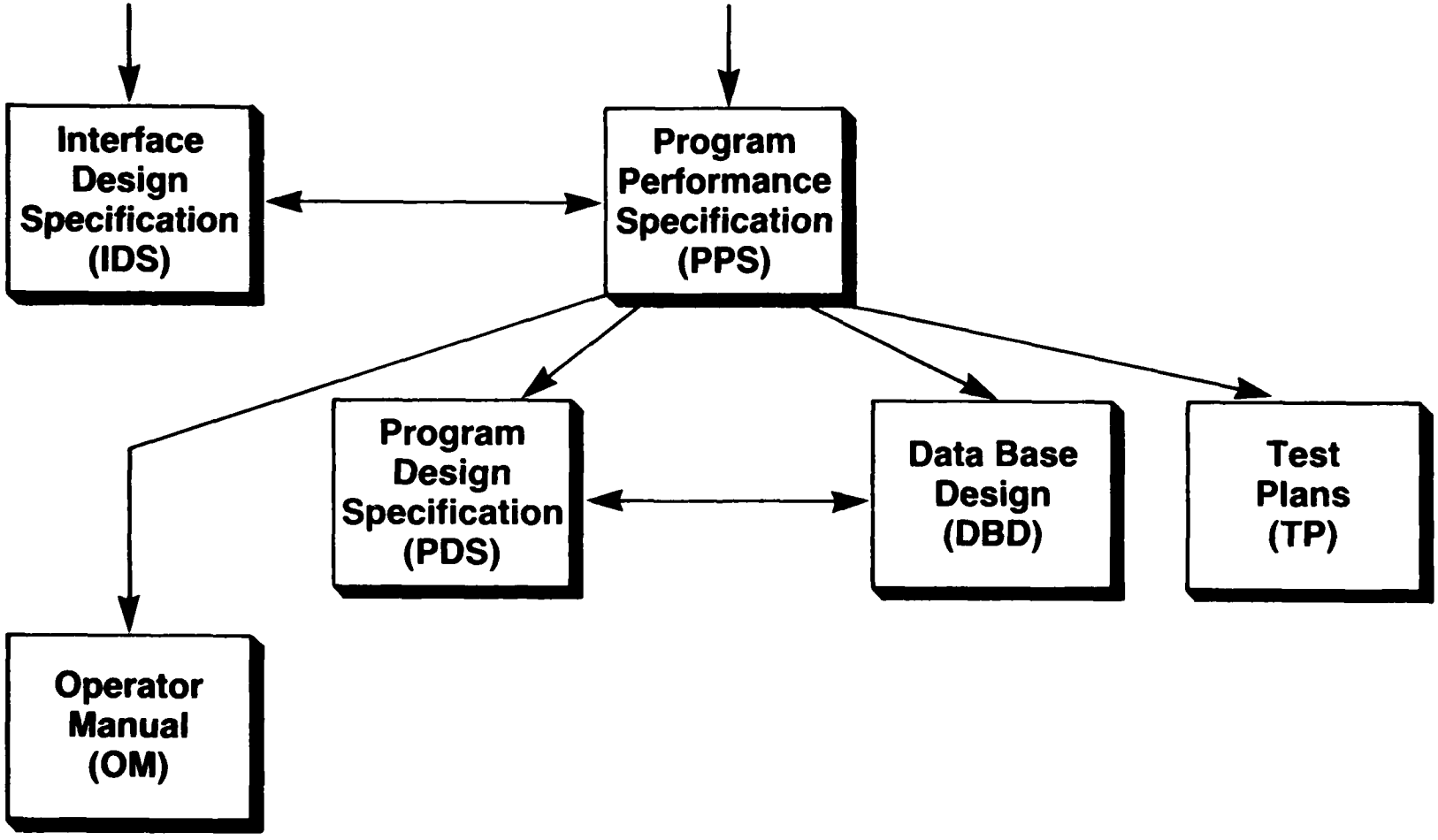

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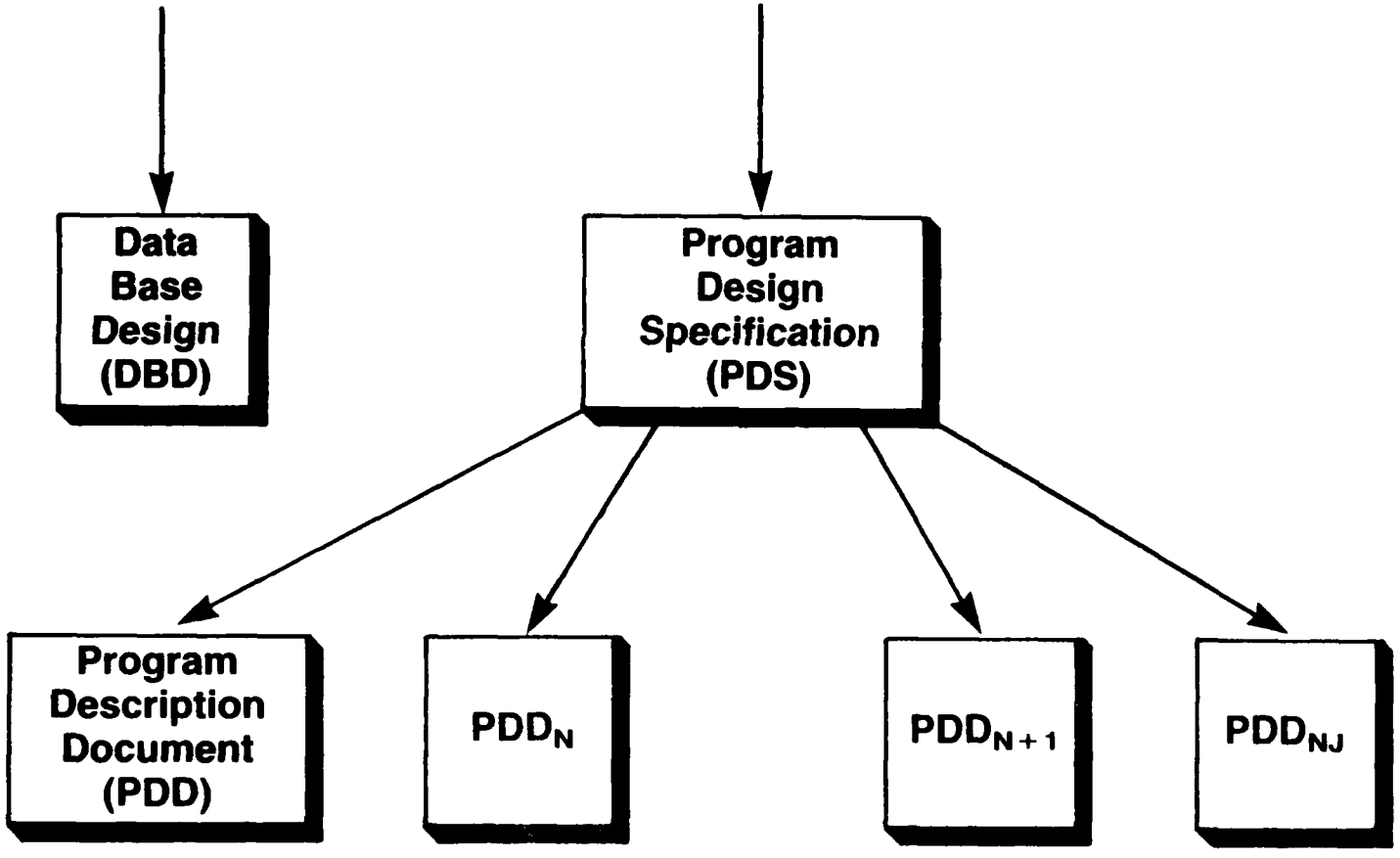

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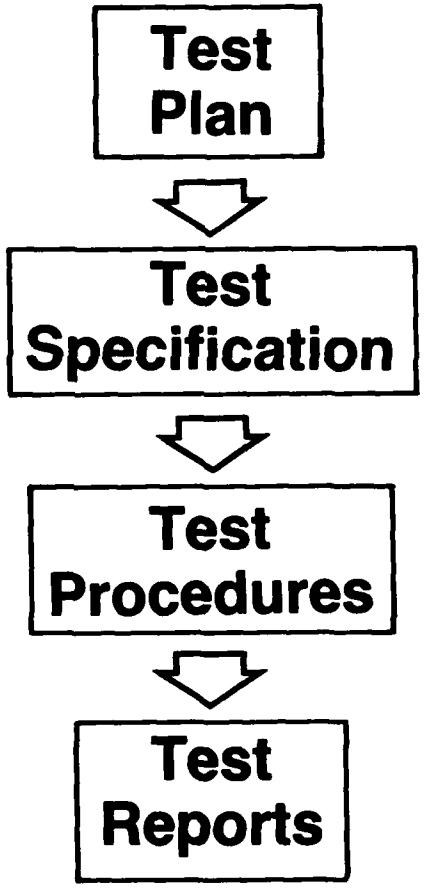

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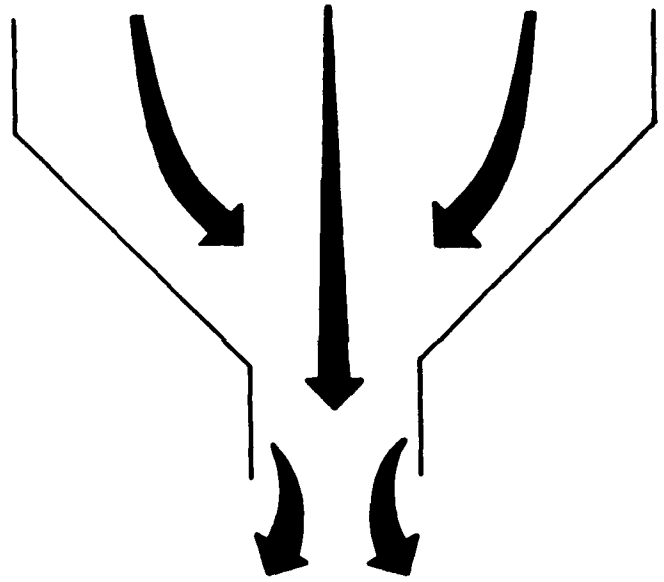


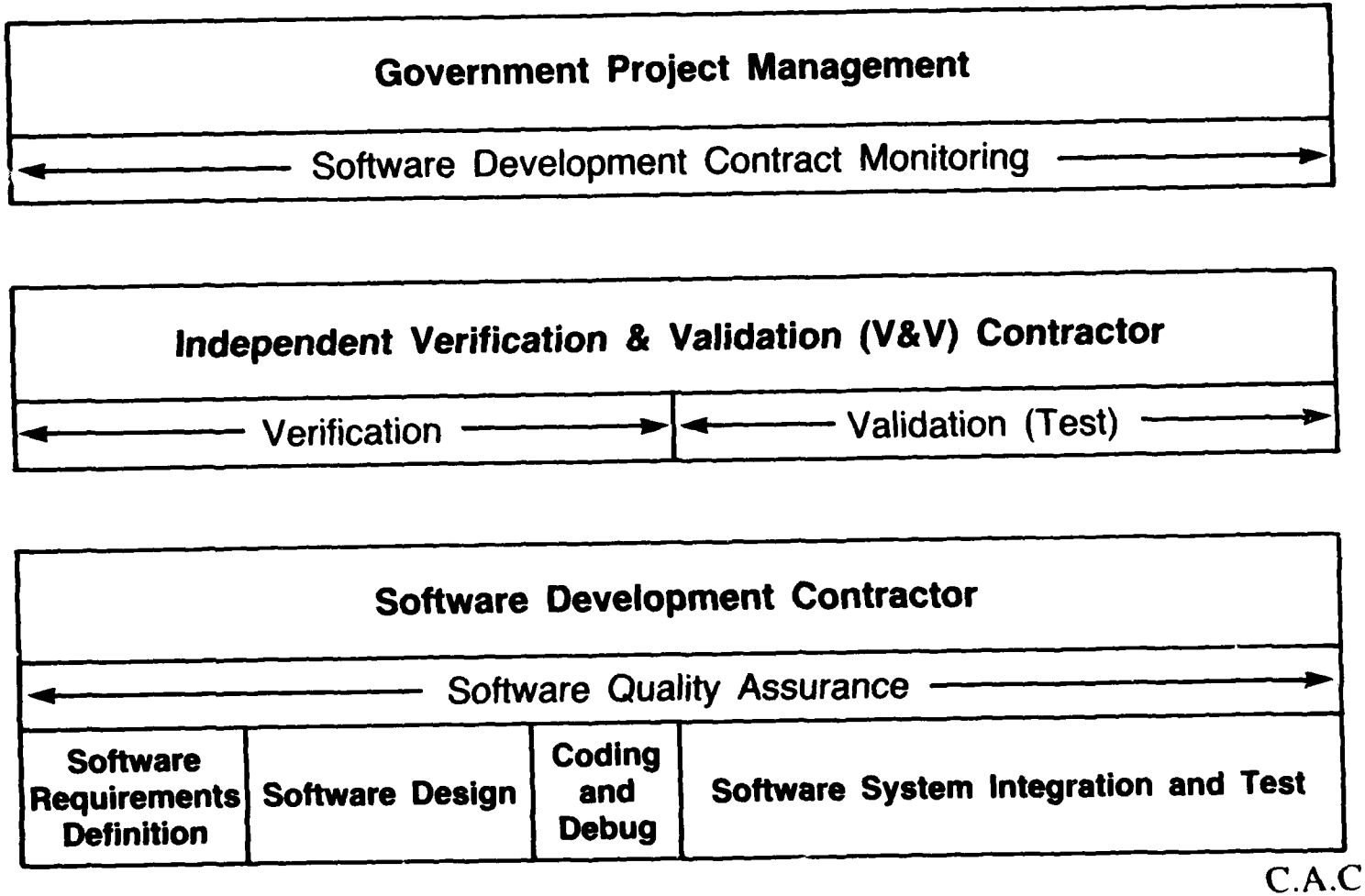
UNIT DEVELOPMENT FOLDER (UDF)

- Overview of UDFs
- Project management tool
- They help force concurrent documentation
- Quality assurance tool
- Configuration management tool
- They are widely used in the industry

PROGRAMMING STANDARDS AND CONVENTIONS MANUAL

- Programmer's bible
- Programming visibility and discipline
- Examples of items to be included:
  - Operating system interface
  - Module-to-module interfacing
  - Program-to-program interfacing
  - Structured programming
  - Module size limitation
  - Parameterization and symbolics
  - Format for source code listing
  - Source code commenting standards
  - Data base interface ground rules
  - Naming conventions
  - Trade-off guidance

SOFTWARE QUALITY RELATIONSHIPS



C.A.C.I.

OUTLINE OF MIL-STD-1679

Forward

- Section 1. Scope
- Section 2. Referenced Documents
- Section 3. Definitions
- Section 4. General Requirements
- Section 5. Detailed Requirements

OUTLINE OF MIL-STD-1679 (Cont.)

- **Section 5. Detailed Requirements**
  - Section 5.1 Program Performance Requirements
  - Section 5.2 Program Design Requirements
  - Section 5.3 Programming Standards
  - Section 5.4 Programming Conventions
  - Section 5.5 Program Production
  - Section 5.6 Program Regeneration
  - Section 5.7 Program Operation
  - Section 5.8 Program Test
  - Section 5.9 Quality Assurance
  - Section 5.10 Program Acceptance
  - Section 5.11 Configuration Management
  - Section 5.12 Management Control
- **Section 6. Miscellaneous**

SOFTWARE QUALITY TEST

- This test is to be used just like a yardstick
- It is only part of the minimum acceptance criteria needed, it must be augmented for total acceptance criteria
- Should be used for both acceptance and life cycle testing
- It is not a replacement for full performance testing, it is merely a special one-time stress test
- It requires its own set of test documentation: plan, specifications, and procedures

DESIGN OF AN ENDURANCE TEST

- Establish definitions
- Identify programs to be tested
- Use configuration-managed (controlled) software
- Conduct in the ultimate environment
- Perform on the full-up system
- Define the duration of the test
- Include the required periods of stress
- Define the amount of allowable degradation
- Make contractually binding

CONDUCT OF AN ENDURANCE TEST

- Conduct by an independent test organization
- Exercise all functions and interfaces
- Test over the full range of inputs
- Ensure that the program is overstressed
- Test for all wrap-around conditions
- Test must run to completion
- Invocation of the auto recovery routine constitutes a test failure
- Test must be rerun completely if a failure occurs

ITEMS OF INTEREST

- It is required on all subcontracts
- Firmware is treated the same as software
- Automatic test equipment and training applications software are included within its coverage
- There are no specific reliability requirements
- Requires verification of the program architecture
- Specifies a limitation on the size of procedures
- It restricts the use of the "GOTO"
- Requires a 20% reserve of computer system resources at the time of program delivery
- Requires delivery of all support software
- Flow charts are not a required deliverable

ITEMS OF INTEREST (Cont.)

- Apparent large number of reviews
- Apparent large amount of deliverable documentation

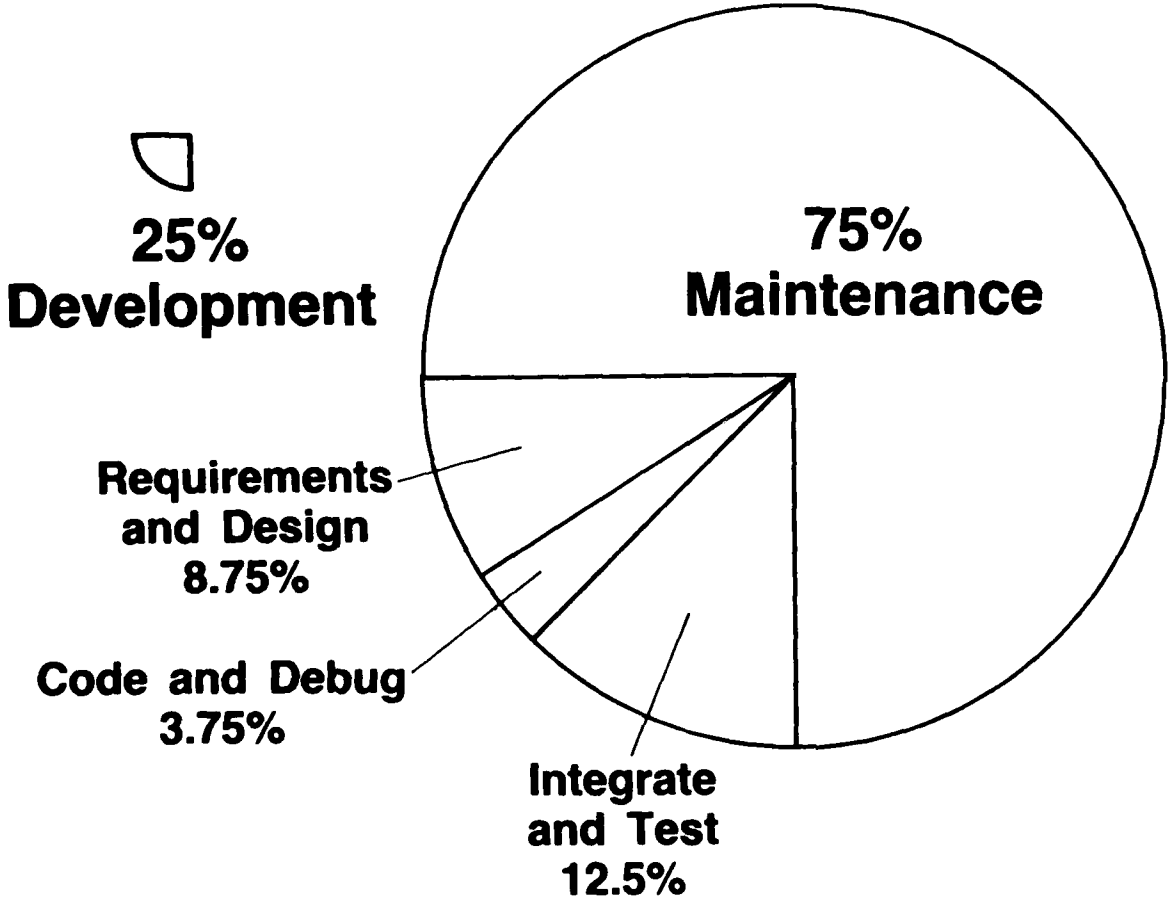
COST OF USING MIL-STD-1679

- The hue and cry
- Work in the standard vs deliverables on 1423
- Software engineering practices
- Quality assurance practices
- Minimum set of requirements

SOFTWARE DEVELOPMENT COSTS

- Requirements and design — 35%
- Code and debug — 15%
- Integrate and test — 50%

SOFTWARE COSTS



MIL-STD-1679's APPLICABILITY

- It is applicable only within the scope of the contract
- It is applicable to projects of any size, even small ones
- It is appropriate for use in all system applications areas
- It is aiso applicable to commercial and ADP applications areas
- It is applicable to the development of firmware
- It can be used with any type of documentation scheme

RELATIONSHIPS

- **To computer program documentation**
  - Describes work in support of the DD Form 1423
  - Supports: SECNAVINST 3560.1, MIL-STD-483, MIL-STD-490, DODI 7935.1S, FIPS PUB 38, et. al.
  - Prescribes a minimum set
- **To software quality assurance:**
  - Philosophically different from MIL-S-52779A
  - Re-enforces the software QA movement
  - QA is not synonymous with "test"
- **To configuration management:**
  - Software CM is integral to system CM
  - Limited to contractor internal software CM
  - Addresses only the developmental baseline
  - Does not conflict/compete with MIL-STD-483
  - Does not conflict/compete with DOD-STD-480A

RELATIONSHIPS (Cont.)

- To government directives and other MIL-STDs:
  - DOD Directive 5000.29
  - DOD Instruction 5000.31
  - DOD Instruction 5000.5X
  - DOD-STD-480A and 481
  - MIL-STD-483
  - MIL-STD-490
  - MIL-STD-1521A
  - MIL-S-52779A
  - MIL-STD-1644
  - SECNAVINST 3560.1
- To tailoring:
  - Only allowable tailoring is upwards
  - Upwards tailoring is required for:
    - Performance requirements
    - Man-machine interfaces
    - System differences
    - Project differences
    - Uniqueness of applications
    - Institutional differences
    - Additional acceptance criteria

CURRENT STATUS

- It is being used widely throughout the government, commercially, and internationally
- It is widely accepted among software engineers
- It is widely accepted throughout the industry
- It is becoming an integral component of RFP/ proposals
- It is influencing contractor internal procedures:
  - Software engineering standards are being promulgated
  - Software quality assurance programs are being established
  - Independent computer program test is emerging
  - Configuration management is becoming visible
  - Central software development facilities are more prevalent

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